Robert C. Colwell, Reg. No. 27,431   *(650) 326-2400*

Applicant: Yuichi Yagawa
Title: Database Query Operations Using Storage Networks
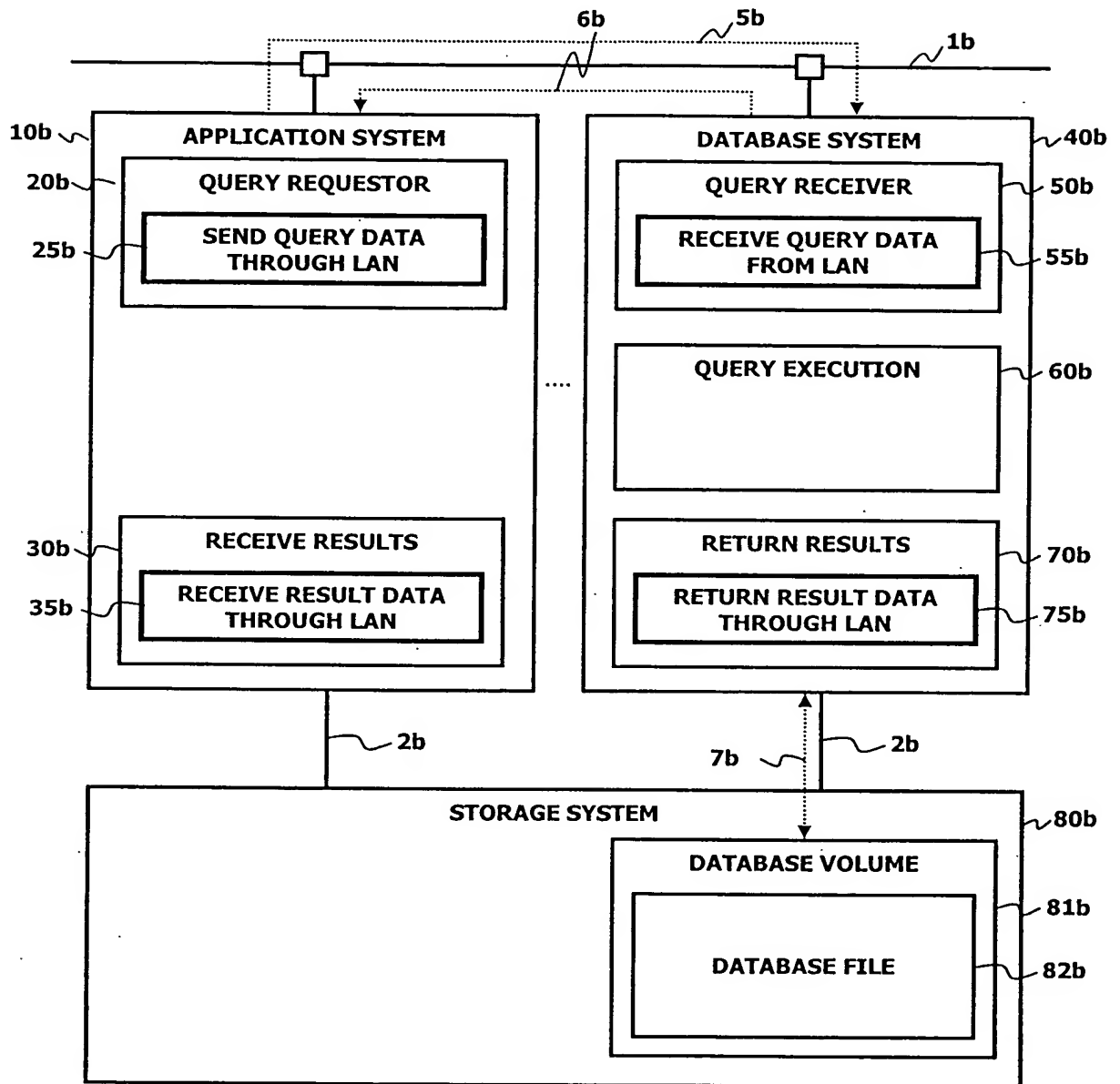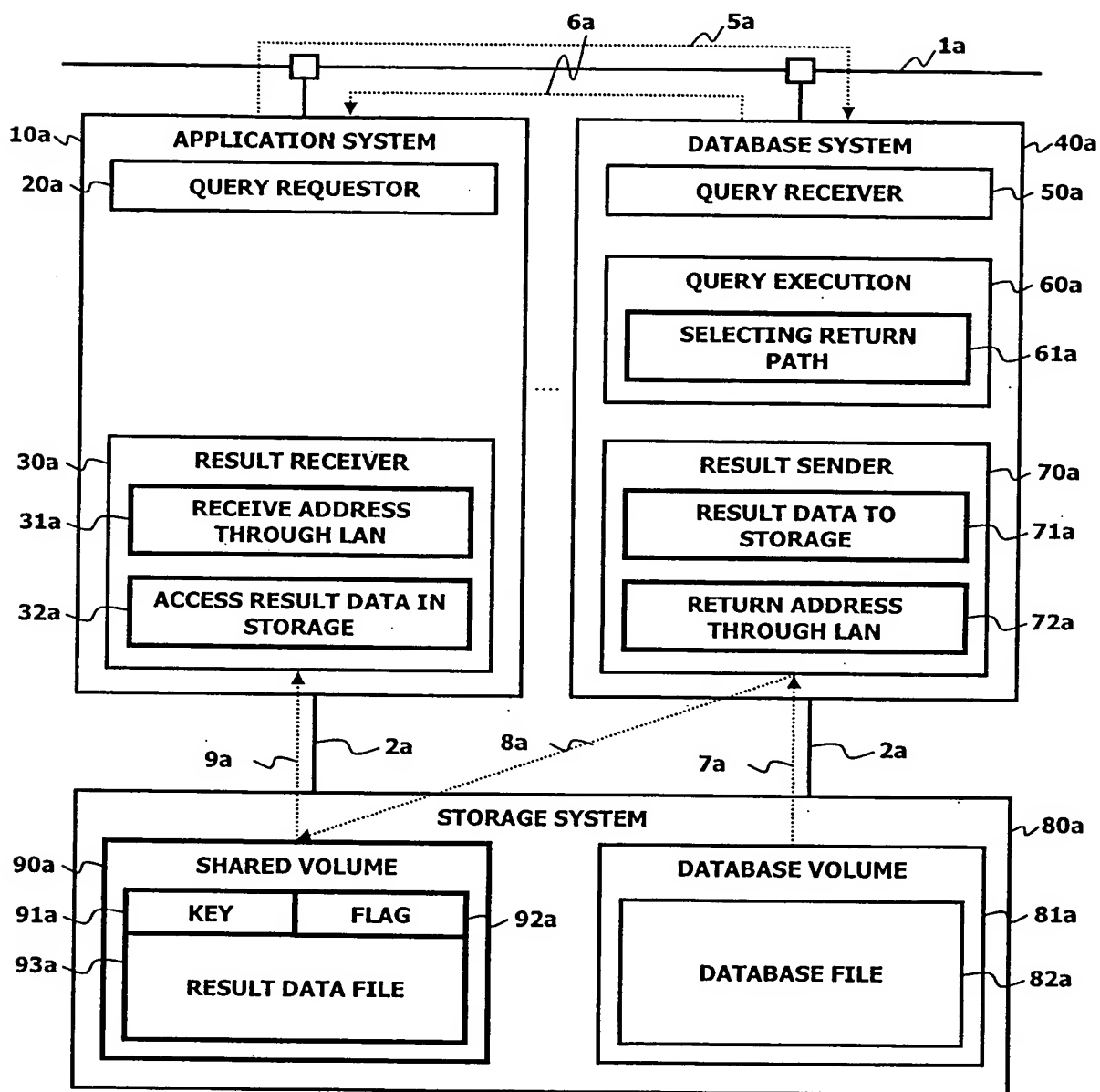**Atty Dock t No.** 16869B-064300
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Figure 1 (Prior Art)

6a   **5a**   **1a**

10a APPLICATION SYSTEM

20a QUERY REQUESTOR

40a DATABASE SYSTEM

50a QUERY RECEIVER

60a QUERY EXECUTION

61a SELECTING RETURN PATH

30a RESULT RECEIVER

31a RECEIVE ADDRESS THROUGH LAN

32a ACCESS RESULT DATA IN STORAGE

70a RESULT SENDER

71a RESULT DATA TO STORAGE

72a RETURN ADDRESS THROUGH LAN

9a   **2a**   **8a**   **7a**   **2a**

80a STORAGE SYSTEM

90a SHARED VOLUME

91a KEY   FLAG **92a**

93a RESULT DATA FILE

81a DATABASE VOLUME

82a DATABASE FILE

Figure 2

Figure 3

141d   140d   1d

10d **APPLICATION SYSTEM**   **DATABASE SYSTEM** **40d**

100d **APPLICATION PROGRAM**   **DATABASE PROGRAM** **120d**

101d CREATE QUERY   RECEIVE QUERY **121d**

EXECUTE QUERY **122d**

102d PROCESS RESULT   RETURN RESULT **123d**

146d   143d

110d **DATABASE ACCESS PROGRAM**   **GATEWAY PROGRAM** **130d**

111d SEND QUERY   HOOK ACCESS TO DATABASE **131d**

SELECT RETURN PATH **61d**

31d RECEIVE ADDRESS THROUGH LAN   STORE RESULT DATA **71d**

32d ACCESSING RESULT DATA IN STORAGE   RETURN ADDRESS THROUGH LAN **72d**

145d   2d   144d   2d

142d

STORAGE SYSTEM **80d**

90d **SHARED VOLUME**   **DATABASE VOLUME**

91d KEY   FLAG   **92d**   **81d**

DATABASE FILE **82d**

93d RESULT DATA FILE

Figure 4

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141e   140e   1e

10e APPLICATION SYSTEM	40e DATABASE SYSTEM
100e APPLICATION PROGRAM	**120e DATABASE PROGRAM**
101e CREATE QUERY	RECEIVE QUERY 121e
	EXECUTE QUERY 122e
102e PROCESS RESULT	RETURN RESULT 123e

146e   143e

110e DATABASE ACCESS PROGRAM	130e GATEWAY PROGRAM
21e SELECT REQUEST PATH	HOOK ACCESS TO DATABASE 131e
22e STORE QUERY DATA	RECEIVE ADDRESS WITN QUERY THROUGH LAN 51e
23e SEND ADDRESS WITH QUERY THROUGH LAN	ACCESS QUERY DATA IN STORAGE 62e

145e   2e   144e   2e   142e

STORAGE SYSTEM 80e

90e SHARED VOLUME	81e DATABASE VOLUME
91e KEY	FLAG 92e	DATABASE FILE 82e
93e RESULT DATA FILE	

Figure 5
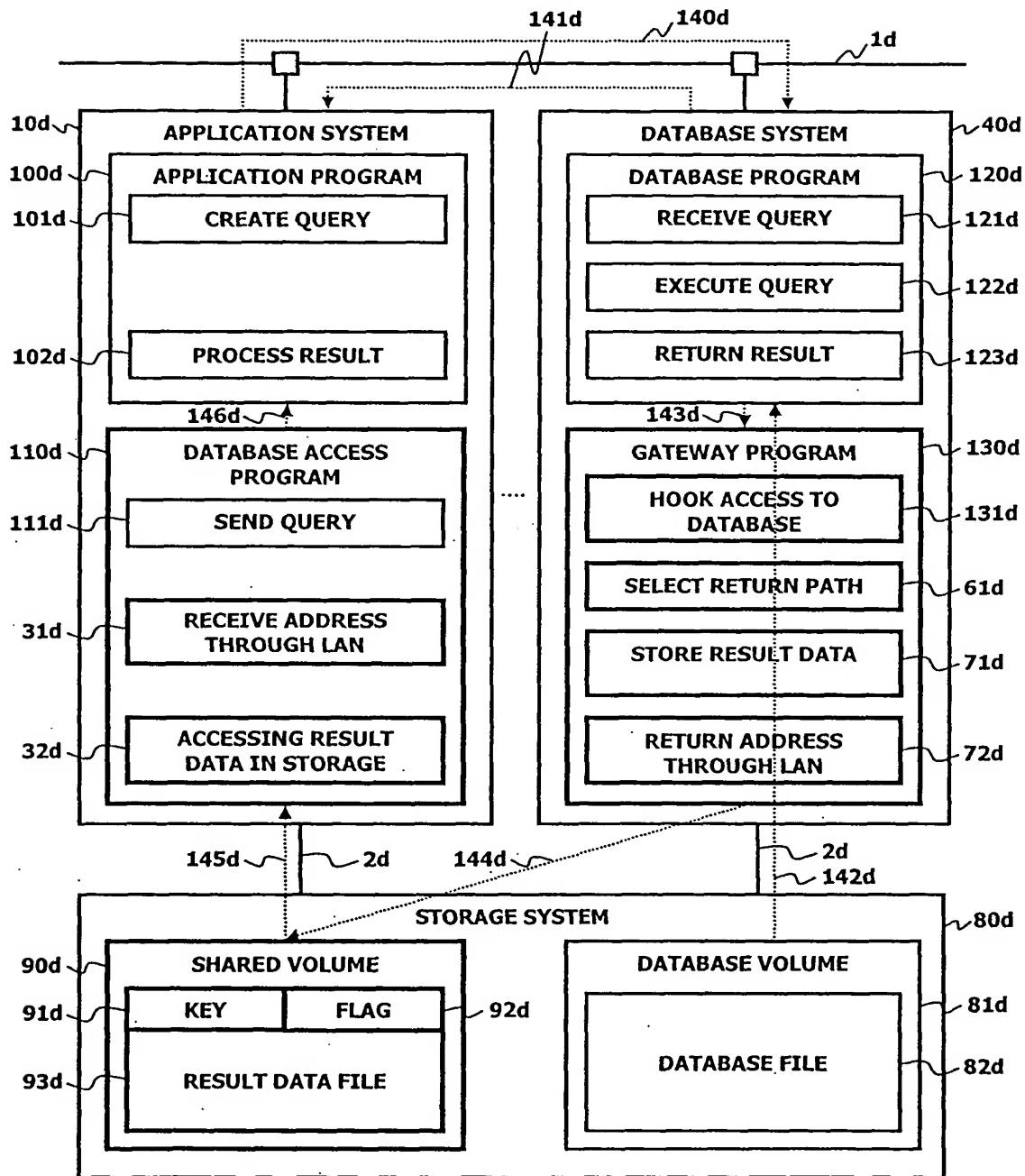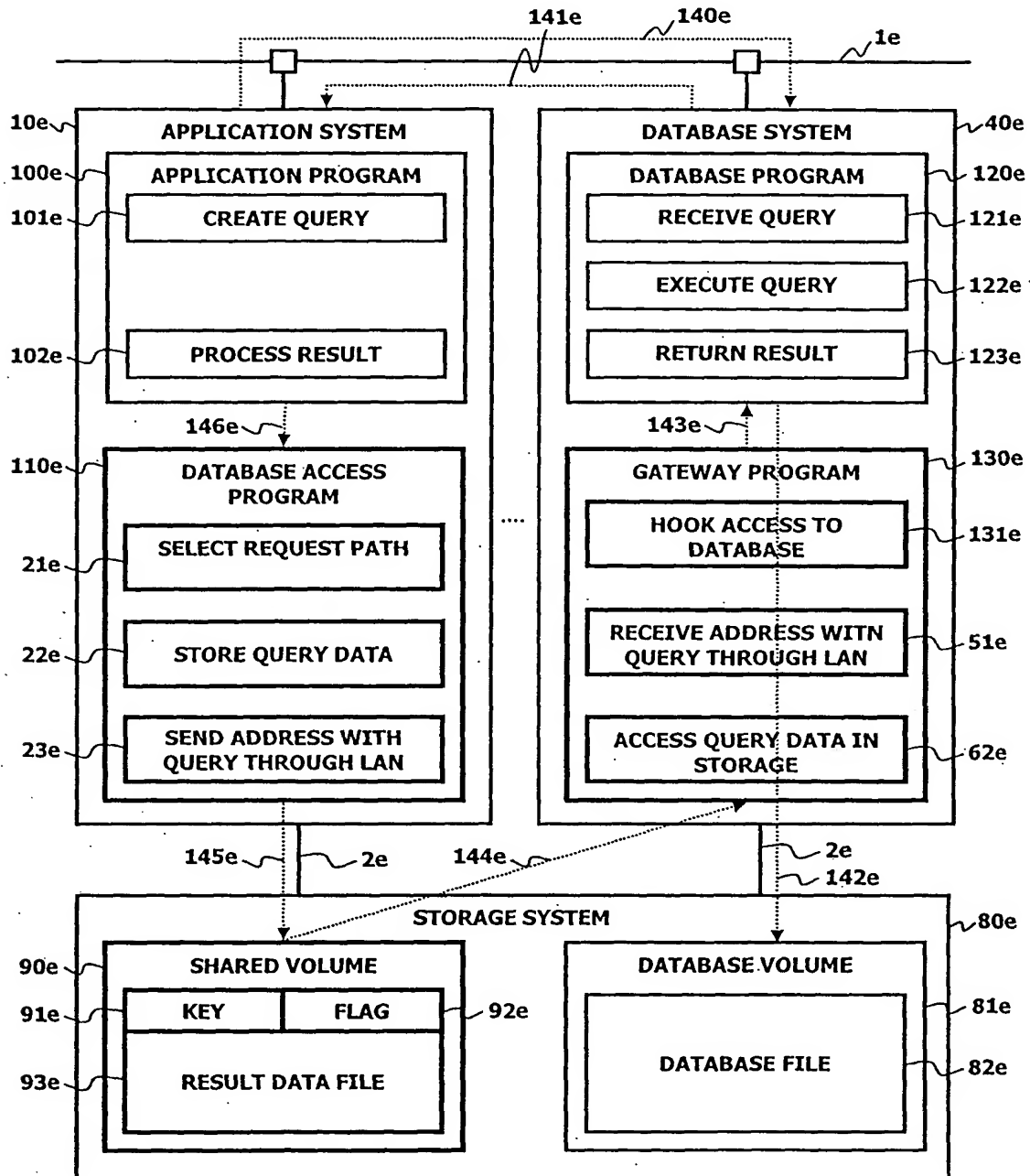
Robert C. Colwell, Reg. No. 27,431   (650) 326-2400

Applicant: Yuichi Yagawa
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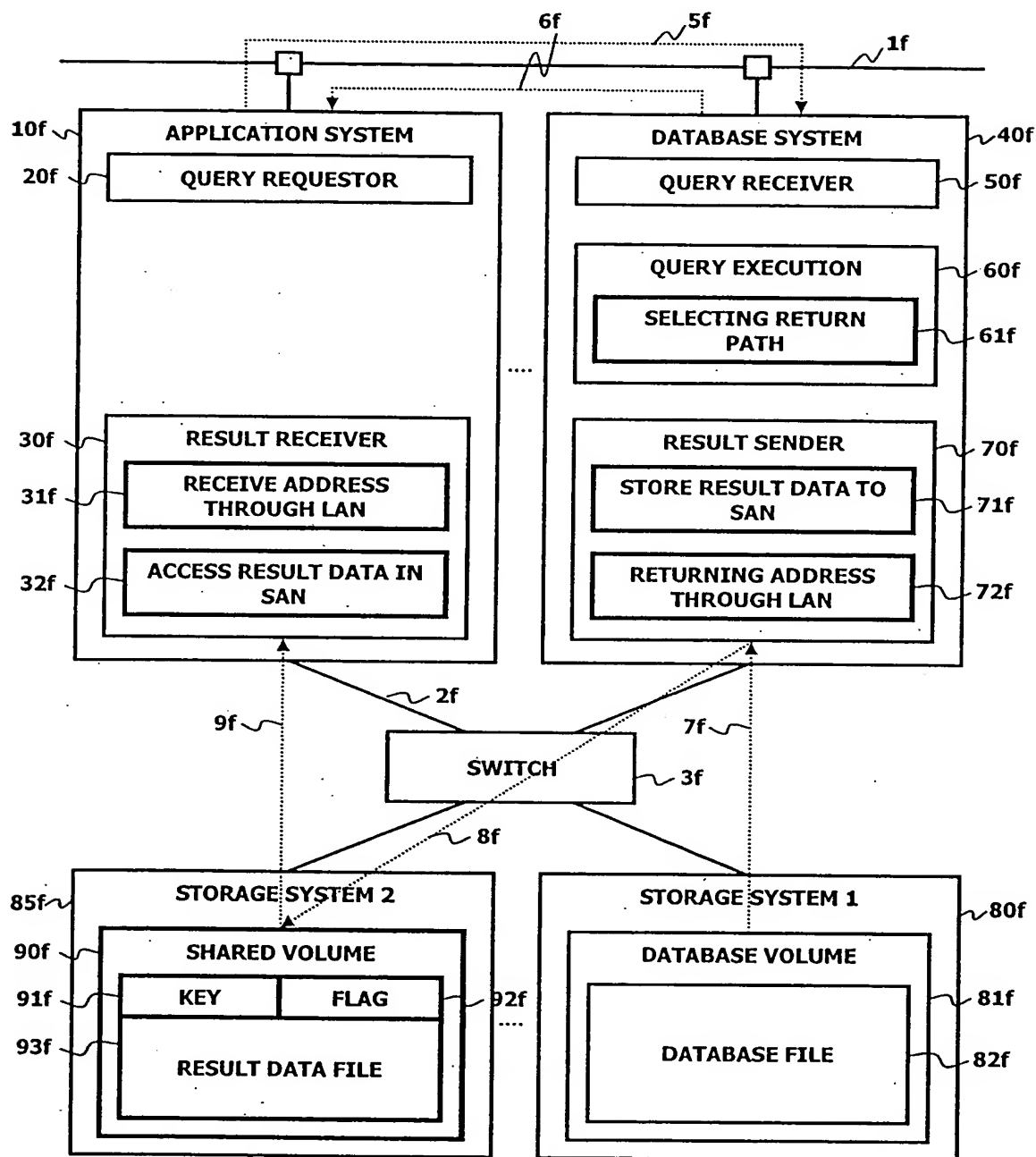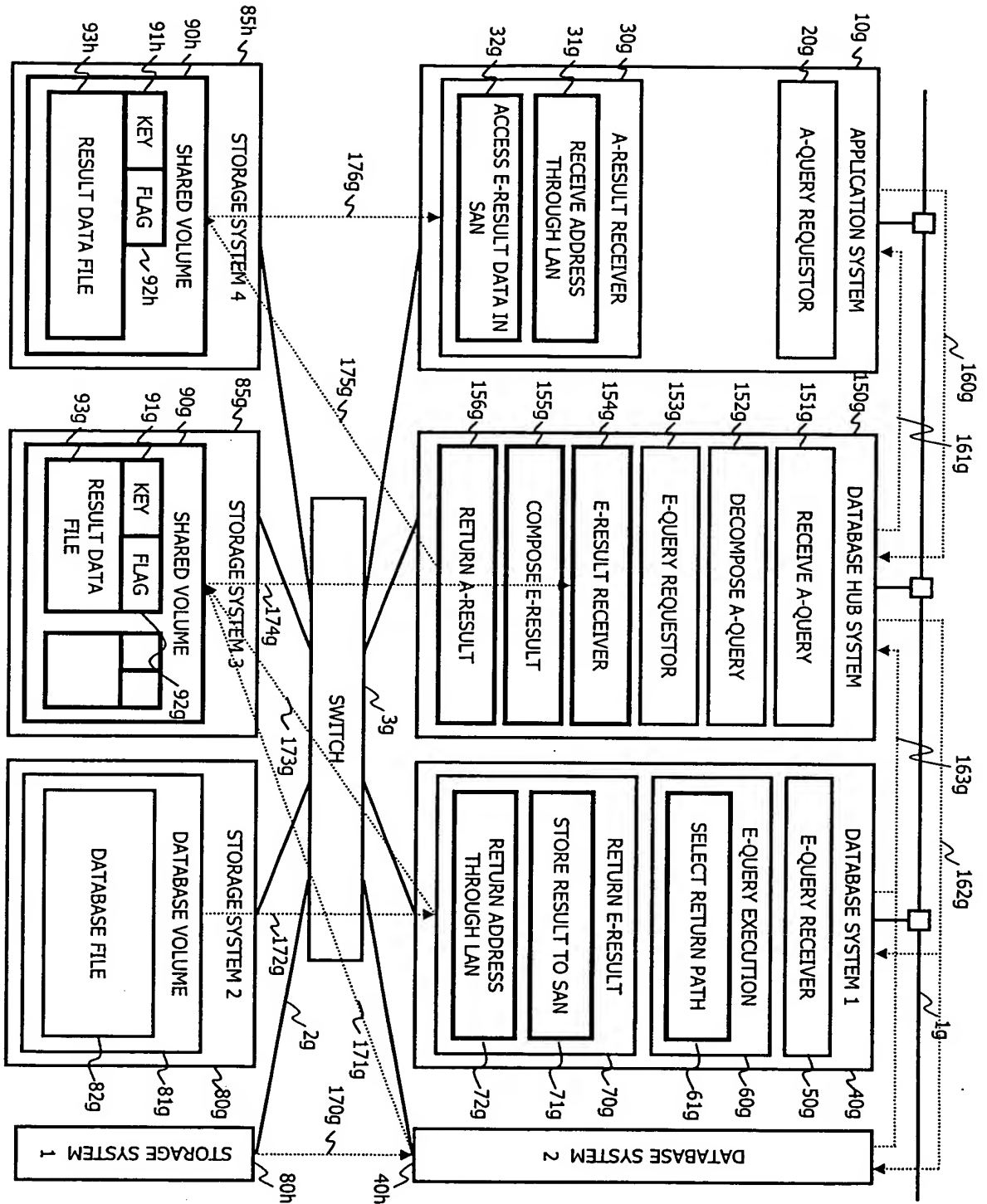Atty Docket No. 16869B-064300
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6f   5f   1f

| 10f | APPLICATION SYSTEM | | DATABASE SYSTEM | 40f |
| 20f | QUERY REQUESTOR | | QUERY RECEIVER | 50f |

QUERY EXECUTION — 60f

SELECTING RETURN PATH — 61f

....

30f	RESULT RECEIVER		RESULT SENDER	70f
31f	RECEIVE ADDRESS THROUGH LAN		STORE RESULT DATA TO SAN	71f
32f	ACCESS RESULT DATA IN SAN		RETURNING ADDRESS THROUGH LAN	72f

2f

9f   SWITCH   7f
3f

8f

85f	STORAGE SYSTEM 2		STORAGE SYSTEM 1	80f
90f	SHARED VOLUME		DATABASE VOLUME	
91f	KEY	FLAG		81f
		92f		
		....		
93f	RESULT DATA FILE		DATABASE FILE	82f

Figure 6

Figure 7

Figure 8

START

GET SIZE OF THE RESULT DATA ~ 220

ALLOCATE A FILE OF THE RESULT DATA IN THE SHARED VOLUME ~ 221

222

ENOUGH SPACE IN THE SHARED VOLUME

NO

223

EXECUTE GARBAGE COLLECTION IN THE SHARED VOLUME

YES

SET A "WRITING" FLAG TO THE FILE ~ 224

STORE THE RESULT DATA TO THE FILE ~ 225

SET A KEY TO THE FILE ~ 226

RESET A "READY" FLAG TO THE FILE ~ 227

RETURN THE ADDRESS AND THE KEY ~ 228

END

Figure 9

START

GET THE STORAGE ADDRESS AND THE KEY — 240

ACCESS TO THE KEY — 241

KEY MATCHED — 242 — NO — RETURN ERROR — 243

YES

CHECK THE FLAG — 244

THE FLAG IS "READY" — 245 — NO

YES

SET A "READING" FLAG TO THE FILE — 246

READ THE FILE — 247

SET A "DONE" FLAG TO THE FILE — 248

END

Figure 10

START

GET QUERY DATA   ∿ 300

CALCULATE SIZE OF THE QUERY DATA   ∿ 301

∿ 302

SIZE > THRESHOLD ?   NO

YES

303 ∿ SET REQUEST PATH TO STORAGE NETWORKS

SET REQUEST PATH TO LAN   ∿ 304

END

Figure 11

START

GET THE SIZE OF THE QUERY DATA ~ 320

ALLOCATE A FILE OF THE RESULT DATA IN THE SHARED VOLUME ~ 321

322
ENOUGH SPACE IN THE SHARED VOLUME

NO → EXECUTE GARBAGE COLLECTION IN THE SHARED VOLUME   323

YES

SET A "WRITE" FLAG TO THE FILE ~ 324

STORE THE QUERY DATA TO THE FILE ~ 325

SET A KEY TO THE FILE ~ 326

RESET A "READY" FLAG TO THE FILE ~ 327

RETURN THE ADDRESS AND THE KEY ~ 328

END

Figure 12

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```
                    ┌──────────────┐
                    │    START     │
                    └──────────────┘
                            │
                            ▼
        ┌───────────────────────────────────┐
        │  GET STORAGE ADDRESS AND KEY       │ ～ 340
        └───────────────────────────────────┘
                            │
                            ▼
        ┌───────────────────────────────────┐
        │        ACCESS TO THE KEY           │ ～ 341
        └───────────────────────────────────┘
                            │
                            ▼
                                     342
              ◇ KEY MATCHED ◇ ──NO──▶ ( RETURN ERROR ) 343
                            │
                           YES
                            ▼
        ┌───────────────────────────────────┐
        │         CHECK THE FLAG             │ ～ 344
        └───────────────────────────────────┘
                            │
                            ▼
                                    345
          NO ◇ THE FLAG IS "READY" ◇
                            │
                           YES
                            ▼
        ┌───────────────────────────────────┐
        │   SET A "READ" FLAG TO THE FILE    │ ～ 346
        └───────────────────────────────────┘
                            │
                            ▼
        ┌───────────────────────────────────┐
        │          READ THE FILE             │ ～ 347
        └───────────────────────────────────┘
                            │
                            ▼
        ┌───────────────────────────────────┐
        │   SET A "DONE" FLAG TO THE FILE    │ ～ 348
        └───────────────────────────────────┘
                            │
                            ▼
                    ┌──────────────┐
                    │     END      │
                    └──────────────┘
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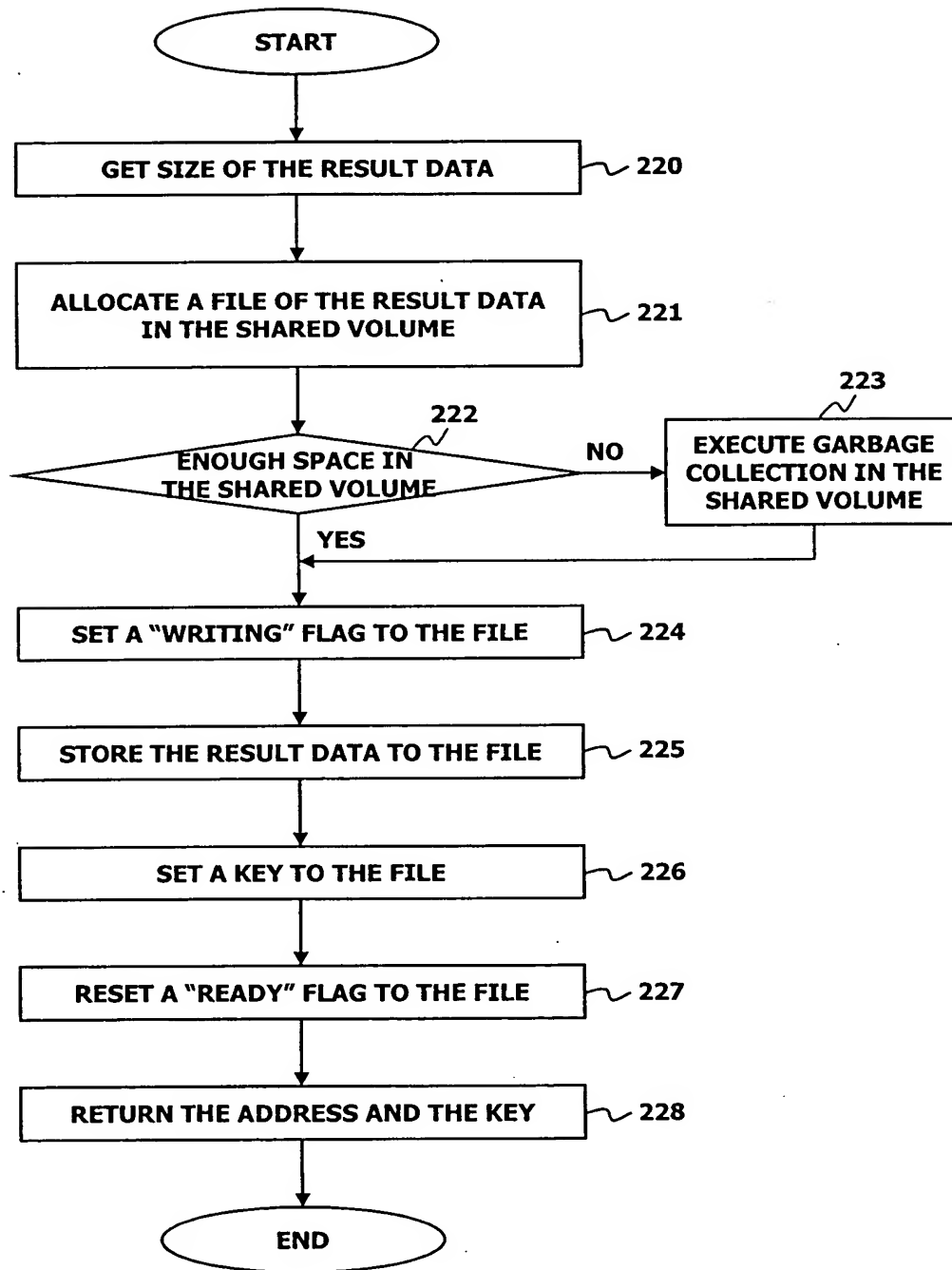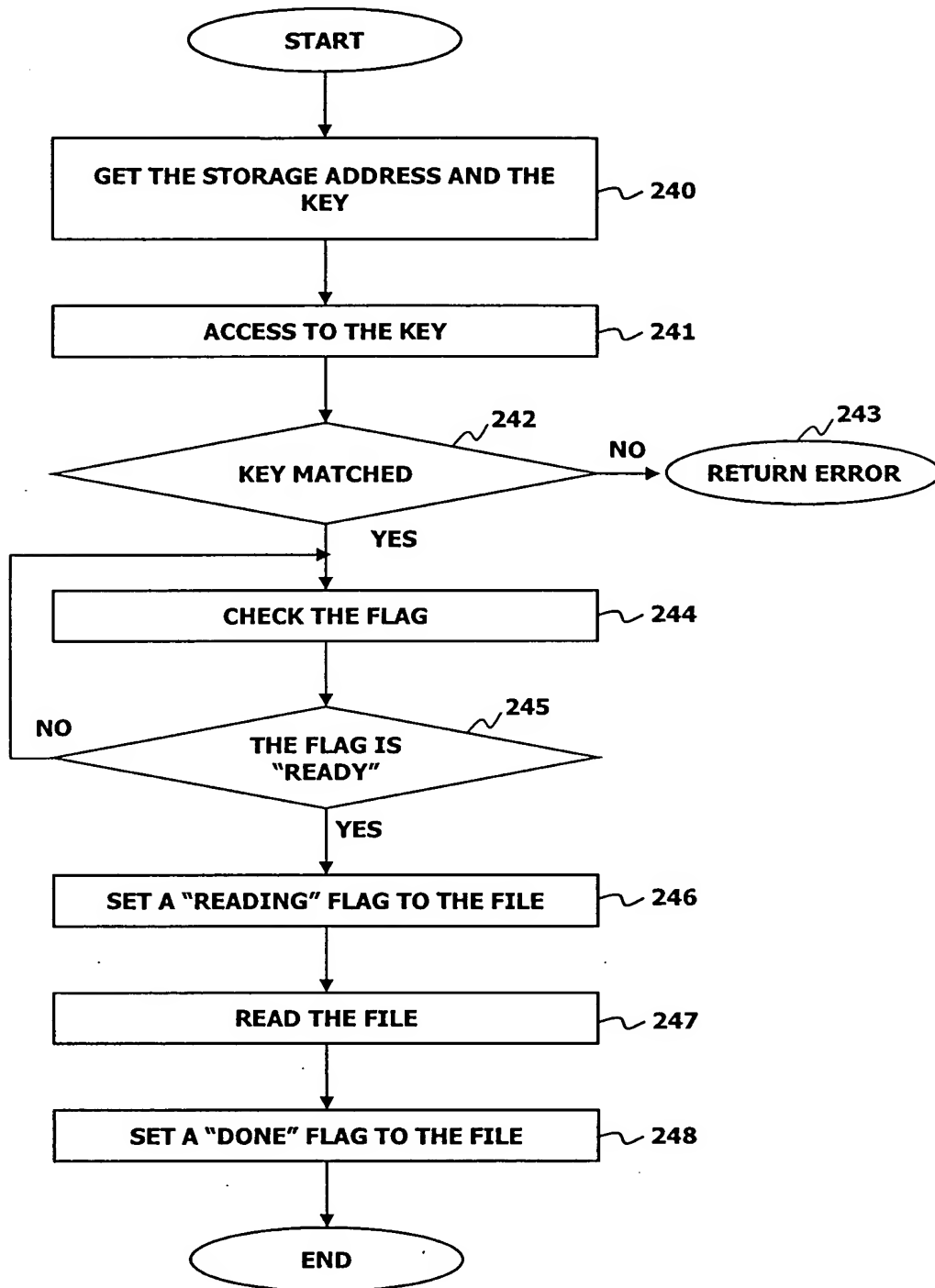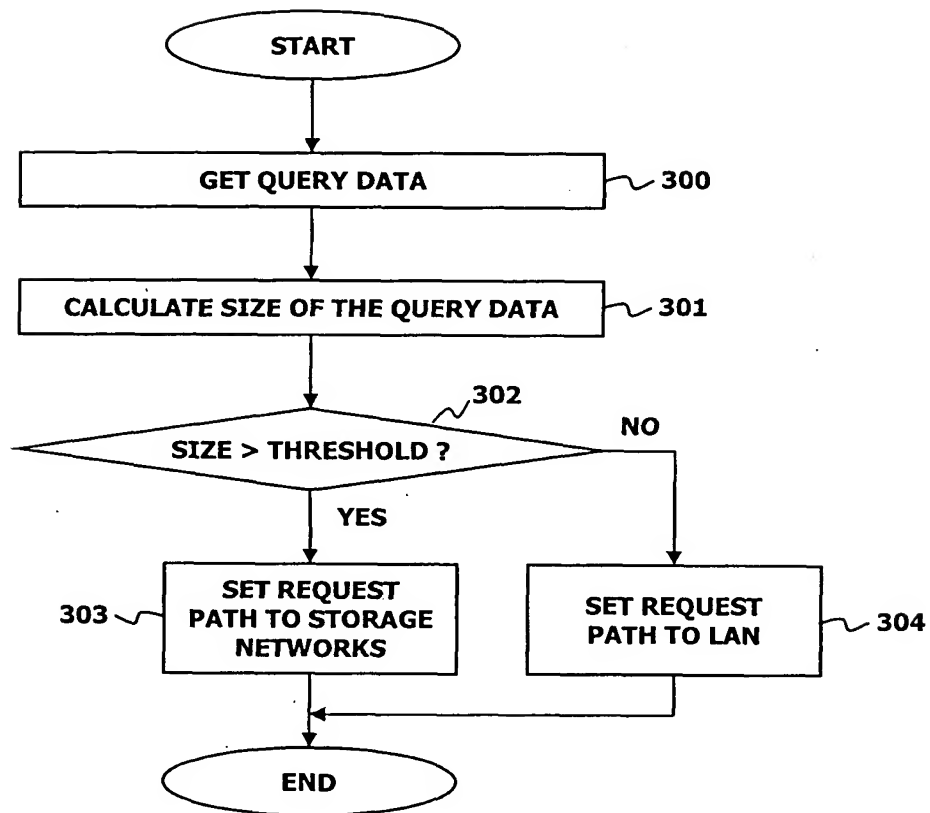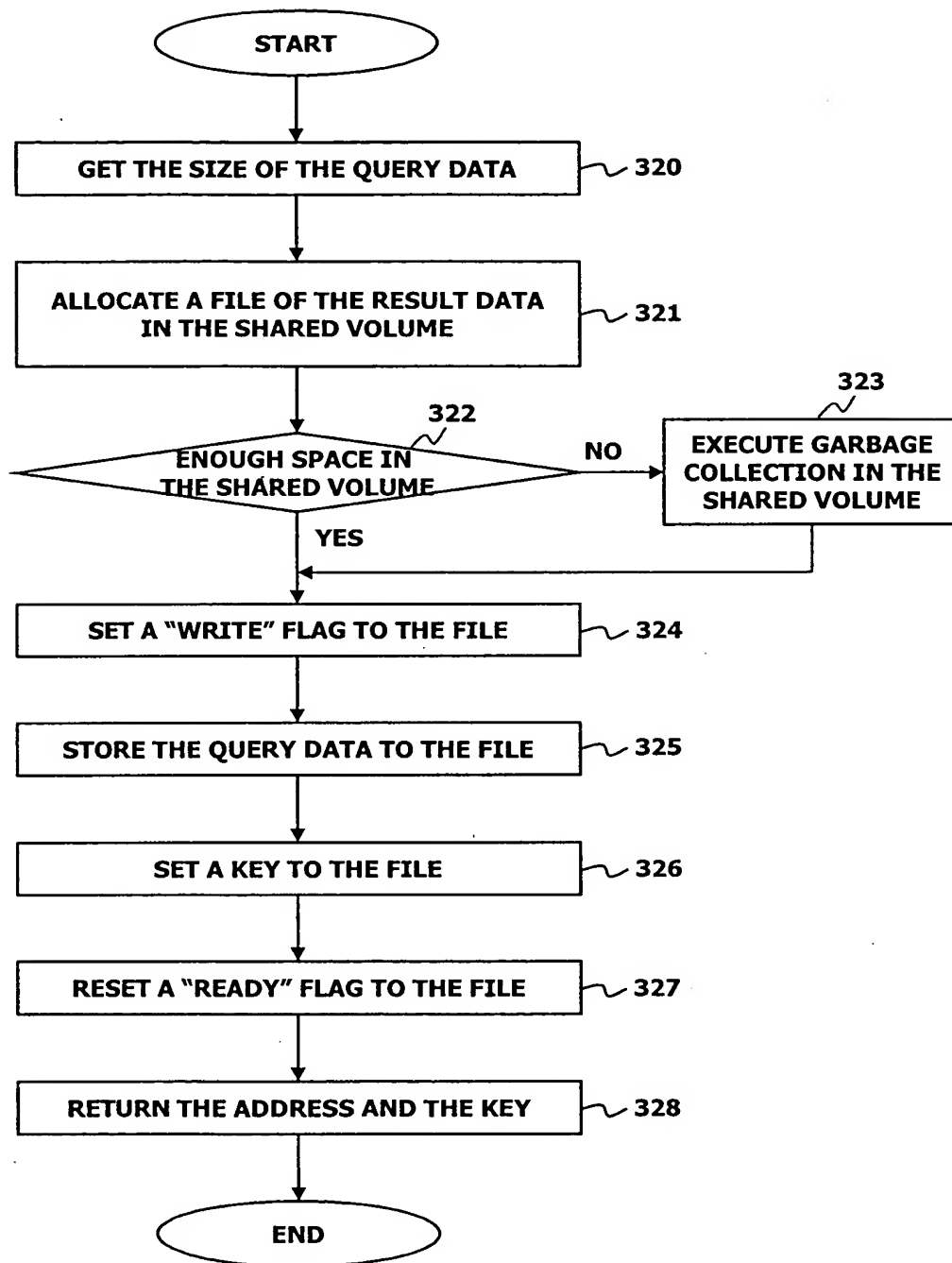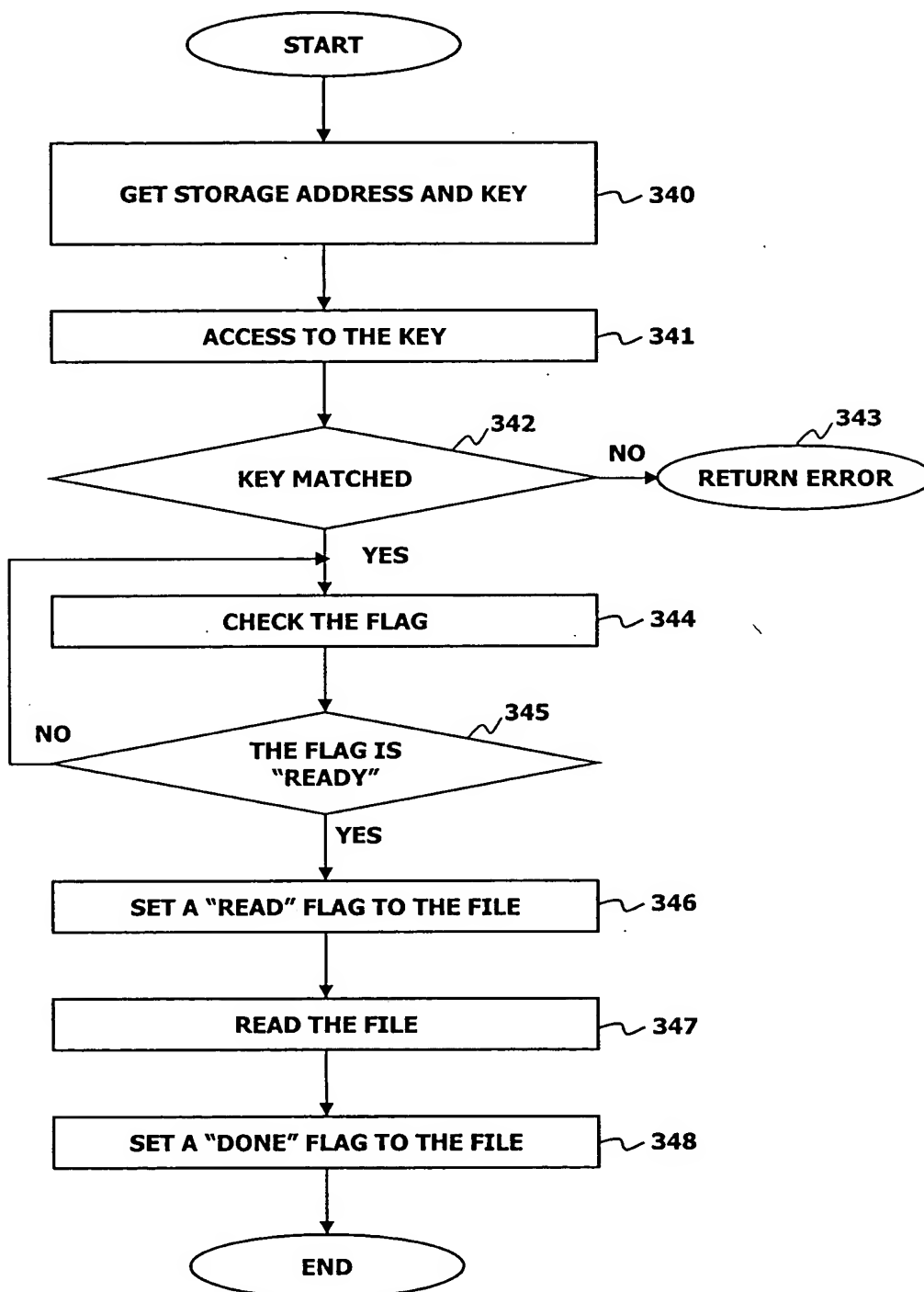
Figure 13